

## REDEFINITION OF TRIBE BACTRINI FALKOVITSH AND REVISED STATUS OF GENERA *TANIVA* HEINRICH AND *HULDA* HEINRICH (TORTRICIDAE: OLETHREUTINAE)

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**Abstract.** The concepts of the tribes Bactrini Falkovitsh and Endotheriini Diakonoff of Falkovitsh (1962), Diakonoff (1973), Kuznetsov and Stekolnikov (1973, 1977, 1984) are reviewed. The tribe Bactrini is redefined on the basis of the morphological structure of the male genitalia, particularly the well-developed, heavily-sclerotized and sharply-recurved uncus, the convex and bent downward tegumen, the near 180° angle formed by the dorsal edge of the basal opening and the basal portion of the costa of the valva, and the absence of coarse setae on the tarsi of the adult of both sexes. The tribe Endotheriini *sensu* Kuznetsov and Stekolnikov, or the subtribe Endotheriina *sensu* Razowski, represented by the genus *Endothernia* Stephens, is removed from the supertribe Gatesclarkeanidii (Kuznetsov & Stekolnikov 1984), from the tribe Gatesclarkeanini (Horak & Brown in press), and from the Olethreutini (Razowski 1989), and assigned to tribe Bactrini. Genera *Taniva* Heinrich and *Hulda* Heinrich are distinguished from *Endothernia*, reassigned to the tribe Olethreutini, and their original generic status is reinstated.

**Additional key words:** Endotheriini, Gatesclarkeanini, taxonomy, male genitalia, tarsal setae.

Falkovitsh (1962) used secondary sexual structures of the male, including the long hairlike scale tuft on the hind tibia and scent glands on the abdomen or on the hindwing, as morphological criteria in the definitions of a number of tribes in the subfamily Olethreutinae. He defined the tribe Bactrini by the total absence of the tibial hair tuft and the wing scent gland. Although these structures are absent in *Bactra* species, they are also absent in various species of other genera of Olethreutinae. Nevertheless, Diakonoff (1973) used these characters and genital structure to define the subtribe Bactrae, a new status for Bactrini, which includes *Bactra* Stephens, a large genus with numerous species worldwide in distribution, and five genera from the south Asiatic region (*Parabactra* Meyrick, *Syntozuga* Lower, *Bubonoxena* Diakonoff, *Cyclacanthina* Diakonoff, *Henioloba* Diakonoff). Diakonoff also proposed a new subtribe, Endotheriinae, consisting of two genera, *Endothernia* Stephens and *Molybdocrates* Diakonoff. *Endothernia* has a moderate number of species and occurs in the Nearctic, Palaearctic, and Oriental regions. *Molybdocrates* is known only from the south Asiatic region with a small number of species. Diakonoff (1973) revised the status of the genus *Endothernia* and synonymized three monotypic genera, *Taniva* Heinrich, *Hulda* Heinrich, and *Tia* Heinrich, under *Endothernia*. This synonymy was accepted in subsequent treatments of the group (Powell 1983, Miller 1987). Kuznetsov (1978) included *Tia* in Olethreutini in the key to genera of Olethreutini in the European part of the

USSR. Although the reason for this transfer was not given, as a result *Tia* was reinstated.

Kuznetsov and Stekolnikov (1984) studied the morphological functions of genital muscles of tortricid males and proposed a classification scheme for the family Tortricidae. In the subfamily Olethreutinae, they recognized three supertribes: Gatesclarkeanidii, consisting of two tribes (Gatesclarkeanini and Endotheniini); Olethreutidii, consisting of three tribes (Microcorsini, Bactrini, and Olethreutini); and Eucosmidii, consisting of three tribes (Enarmoniini, Eucosmini, and Laspeyresini). They suggested that Bactrini and Microcorsini are related and that Endotheniini differs from Bactrini and other species of Olethreutinae (except species of the tribe Gatesclarkeanini) by the absence of the tergal extensor of the valva, muscle m2. Subsequently, Endotheniini is being synonymized under Gatesclarkeanini by Horak and Brown (in press), also on the basis of the absence of the muscle m2 in the male genitalia of these two tortricid groups. Razowski (1989) recognized five tribes in the subfamily Olethreutinae: Microcorsini, Bactrini, Olethreutini, Eucosmini and Grapholitini. According to this arrangement, Olethreutini includes a number of subtribes as proposed by Diakonoff (1973), of which the Endotheniina and the Gatesclarkeanina are relevant to the present study.

Generic descriptions of the taxa involved in this study were given by Heinrich (1926) (*Taniva*, *Tia*, *Hulda*, *Endothenia*, and *Bactra*), Diakonoff (1956) (*Bactra*), Diakonoff (1973) (*Bactra* and *Endothenia*). Therefore, these descriptions are not repeated here.

#### MATERIALS AND METHODS

The following species of tribes Bactrini, Endotheniini s.s., Olethreutini, Gatesclarkeanini, and Microcorsini were examined (information in parentheses indicates geographic regions where specimens were collected):

*Bactra lanceolana* (Hübner) (N. Amer.), *B. furfurana* (Haworth) (N. Amer.), *B. verutana* Zeller (N. Amer. & Japan), *B. maiorina* Heinrich (N. Amer.), *B. priapeia* Heinrich (N. Amer.), and *B. sinistra* Heinrich (N. Amer.) in the Canadian National Collection (CNC), *B. janseni* Diakonoff (S. Afr.), *B. confusa* Diakonoff (S. Afr.), *B. scrupulosa* Meyrick (S. Afr.), *B. spinosa* Diakonoff (S. Afr.), *B. stagnicolana* Zeller (S. Afr.), *B. sardonica* (Meyrick) (S. Afr.), *B. pythonia* Meyrick (S. Afr.), *B. aletha* Diakonoff (W. Afr.), *B. tylophora* Diakonoff (Uganda), *B. nea* Diakonoff (Angola), *B. endea* Diakonoff (Gambia), *B. fasciata* Diakonoff (Natal), *B. venosana* Zeller (Pengal), *B. sinassula* Diakonoff, *B. optanias* Meyrick (Ceylon), *B. canopepla* Turner (Ceylon), *B. tornastis* Meyrick (Ceylon), *B. copidotis* Meyrick (Ceylon), *B. metriacma* Meyrick (Ceylon), *B. leucogama* Meyrick (Ceylon), *B. cerata* (Meyrick) (Ceylon), *B. fracta* Diakonoff (India), *B. phaulopa* Meyrick (Palawan), *B. coronata* Diakonoff (Java), *B. clarescens* Meyrick (Jamaica), *B. philoherda* Diakonoff (Jamaica), *B. seria* Meyrick (S. Amer.), *B. erasa* Meyrick (S. Amer.), *B. perisema* Diakonoff (S. Amer.), *B. robustana* (Christoph) (England & Japan), *B. simpliciana* Chrétien (?loc.), *B. hostilis* Diakonoff (Japan), *B. festa* Diakonoff (Japan), *B. honesta* Meyrick (Australia),

*B. rhadonoma* Diakonoff (N. Zealand), *B. boschmai* Diakonoff (N. Guinea), *B. difissa* Diakonoff (N. Guinea), and *B. straminea* (Butler) (Hawaii) in the British Museum (Natural History) (BMNH); *Endothenia montanana* (Kearfott) (N. Amer.), *E. heinrichi* McDunnough (N. Amer.), *E. rubipunctana* (Kearfott) (N. Amer.), *E. sordulenta* Heinrich (N. Amer.), *E. melanosticta* (Walsingham) (N. Amer.), *E. affliana* McDunnough (N. Amer.), *E. hebesana* (Walker) (N. Amer.), *E. infuscata* Heinrich (N. Amer.), *E. nubilana* (Clemens) (N. Amer.), *E. atrata* (Caradja) (Japan), and *E. banausopsis* (Meyrick) (Japan) in CNC; *E. gentianeana* (Hübner) (Europe), *E. oblongana* (Haworth) (Europe), *E. sellana* (Gué.) (Europe), and *E. nigricostana* (Haworth) (Europe) in BMNH; *Microcorses marginifasciata* Walsingham (Japan) in the U.S. National Museum of Natural History (USNM), same species (Japan, Nepal) and *M. trigonana* (Walsingham) in BMNH; *Cryptasasma triopis* Diakonoff (Guam), *C. lugubris* (Felder) (Texas) in USNM, same species (F. Guyana, Brazil, B. Honduras, Colombia) in BMNH; *Gatesclarkeana erotias* (Meyrick) (India), and *G. idia* Diakonoff (Thailand) in BMNH; *Taniva albolineana* (Kearfott) (N. Amer.), *Tia enervana* (Ersch.) (N. Amer.), and *Hulda impudens* (Walsingham) (N. Amer.) in CNC.

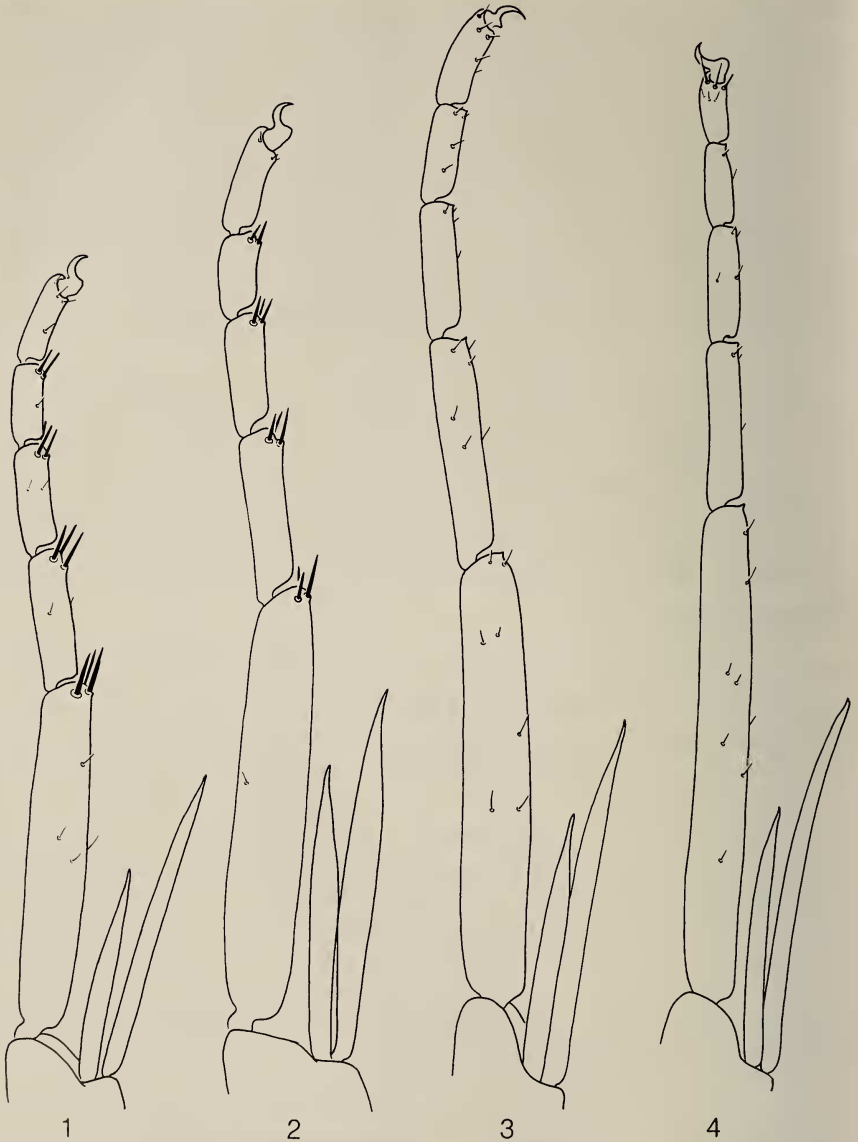
Most North American tortricid species, which are unlisted here, belonging to tribes Cochylini, Sparganothini, Hilarographini, Archipini, Tortricini, Olethreutini, Eucosmini, and Laspeyrsiini were also examined to determine the degree of development of tarsal setation. Additional morphological information on *Bactra* and *Endothenia* species was obtained from the literature (Diakonoff 1956, 1959, 1962, 1963, 1964, 1973, Graaf Bentinck & Diakonoff 1968, Clarke 1958, Kuznetsov 1978, Razowski 1989).

In the majority of cases, leg setae, especially those on the lower margin of the apex of tarsomeres, can be observed directly from pinned specimens (Figs. 1–4). Tarsomeres without developed setae were descaled so that the presence of fine setation could be confirmed; legs were macerated in gently boiling 20% KOH solution for 3–5 min so that scales could be easily removed to reveal setation of tarsomeres. Legs were then mounted permanently in Canada balsam on microscope slides. Genitalia were studied and illustrated while floating in glycerin so that natural shapes of the uncus and other parts of the genitalia could be studied without distortions or deformations due to pressure from a cover slip. Morphological structures of selected specimens were illustrated with the help of a camera lucida and a microprojector. Observations were made at magnifications of 40 $\times$ , 80 $\times$  and 200 $\times$  with dissecting and compound microscopes.

## RESULTS AND DISCUSSION

Distributions of morphological characters among selected tortricid genera are given in Table 1.

Examinations of the male genitalia of *Endothenia hebesana* (Walker), *E. melanosticta* (Walsingham), and *E. nubilana* (Clemens) revealed that muscle m2 in the male genitalia of these three Nearctic *Endothenia* species is actually present and developed (Fig. 8A). This finding is contrary to Kuznetsov and Stekolnikov (1977, 1984), who reported that



FIGS. 1-4. Hind tarsi of males of Olethreutinae. 1, *Taniva albolineana* (Kearfott); 2, *Tia enervana* (Ersch.); 3, *Bactra furfurana* (Haworth); 4, *Endothenia hebesana* (Walker).

TABLE 1. Distribution of morphological characters in various genera of Bactrini, Gatesclarkeanini, Olethreutini, and Microcorsini.

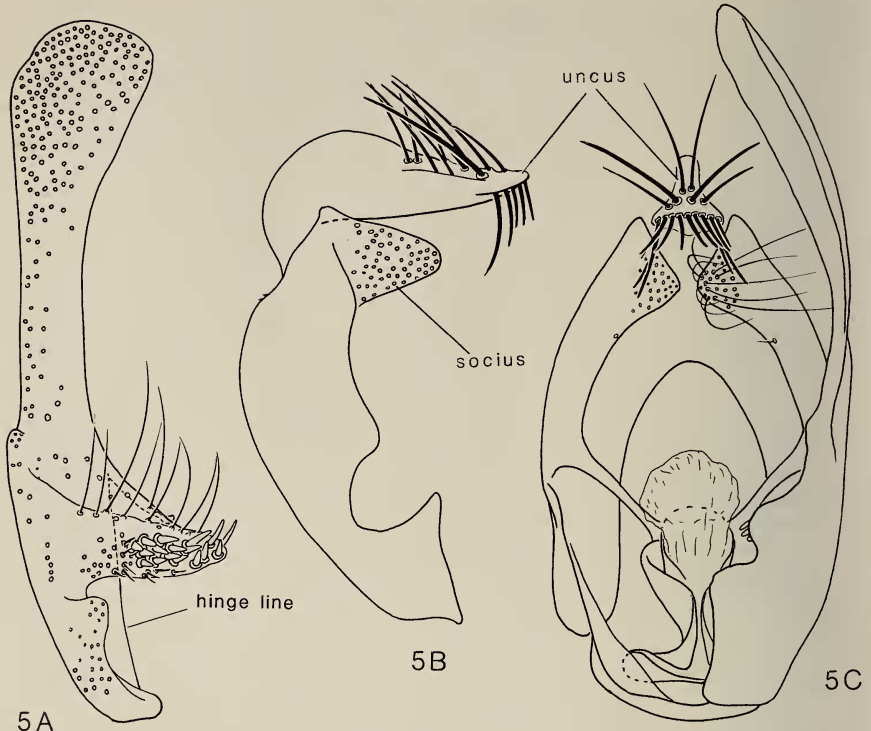
Taxa	Characters						
	1	2	3	4	5	6	7
<b>Bactrini</b>							
<i>Bactra</i>	-	-	+	-	+	+	+
<i>Endothenia</i>	+/-	-	+	-	+	+	+
<b>Gatesclarkeanini</b>							
<i>Gatesclarkeana</i>	+	-	-	-	-	-	-
<b>Olethreutini</b>							
<i>Episimus</i>	-	+	-	-	-	-	(+)
<i>Apotomis</i>	+	+	-	-	-	-	+
<i>Endopiza</i>	+	+	-	-	-	-	(+)
<i>Lobesia</i>	+	+	-	-	-	-	+
<i>Ahmosia</i>	+	+	-	-	-	-	(+)
<i>Eumarozia</i>	-	+	-	-	-	-	(+)
<i>Zomaria</i>	-	+	-	-	-	-	(+)
<i>Pseudosciaphila</i>	-	+	-	-	-	-	(+)
<i>Orthotaenia</i>	+	+	-	-	-	-	+
<i>Olethreutes</i>	+/-	+	-	-	-	-	+
<i>Phaecasiophora</i>	+	+	-	-	-	-	(+)
<i>Hedya</i>	+/-	+	-	-	-	-	(+)
<i>Evora</i>	+	+	-	-	-	-	(+)
<i>Taniva</i>	+	+	-	-	-	-	(+)
<i>Tia</i>	+	+	-	-	-	-	(+)
<i>Hulda</i>	+	+	-	+	-	-	(+)
<b>Microcorsini</b>							
<i>Microcorses</i>	-	+	-	-	-	-	+
<i>Cryptaspasma</i>	-	+	-	-	-	-	+

Explanation of characters: 1: Hair tuft on male hind tibia. 2: Setae on distal ends of male and female tarsomeres 1-4 well developed, spinelike. 3: Uncus well developed, heavily sclerotized, strongly recurved forming dorsal fold or pit at base. 4: Socii heavily sclerotized, surface of distal half smooth. 5: Tegumen convex bent downward. 6: Hinge line and basal portion of costa of valva parallel, or forming a straight line; costal hook unpronounced. 7: Tergal extensor of valva of male genitalia, muscle m2 (only ♂ genitalia of *Bactra* and *Endothenia* were examined for this character in the present study, those of others based on data by Kuznetsov & Stekolnikov (1973, 1977, 1984), (+) indicates a theoretical assumption of the presence of m2 based on the above authors' concept of tribe Olethreutini). +/-: Confirmation of above characters: +, affirmative or present; -, negative or absent.

muscle m2 is absent in *E. marginana* (Haworth), leading them to propose the classification scheme outlined above. In light of this new evidence, the placements of Endotheniini in the supertribe Gatesclarkeanidii by Kuznetsov and Stekolnikov (1984) and in the tribe Gatesclarkeanini by Horak and Brown (in press) need to be reassessed and revised.

In fact, unlike previously thought, *Endothenia* shows marked similarity to *Bactra* in the following four sets of characters, which can be found nowhere else in the Tortricidae:

a) The uncus of these two genera is well developed, heavily sclerotized, and sharply recurved with a sharp fold or pit dorsally near the base and with strong, stout, and blunt setae in apical and subapical areas; in *Bactra* species, setae are arranged into a more or less continuous



5A

5B

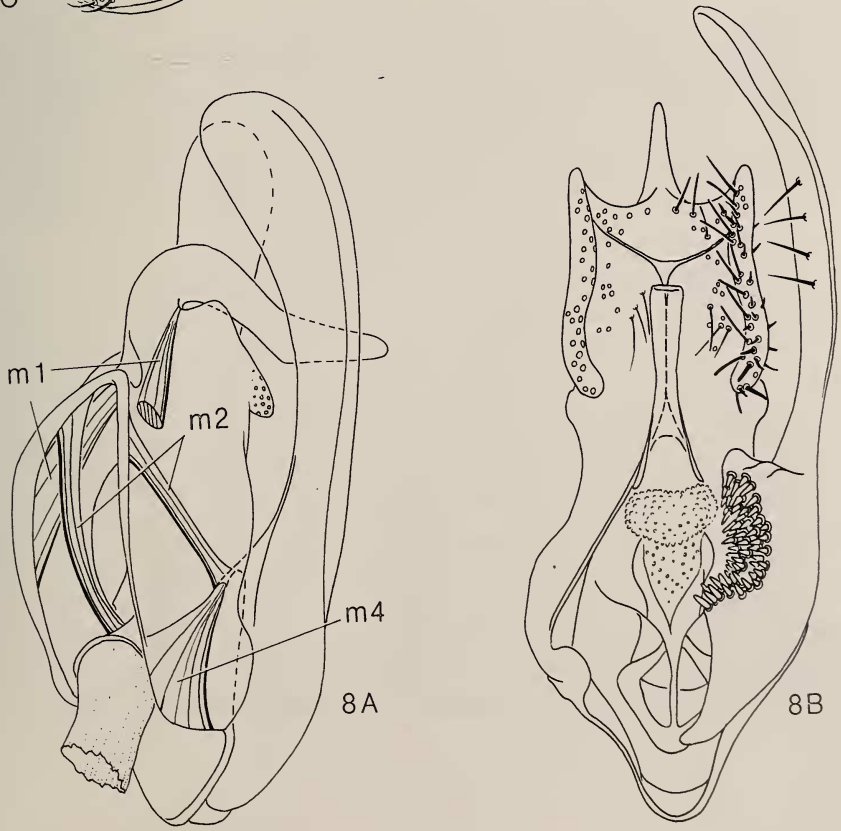
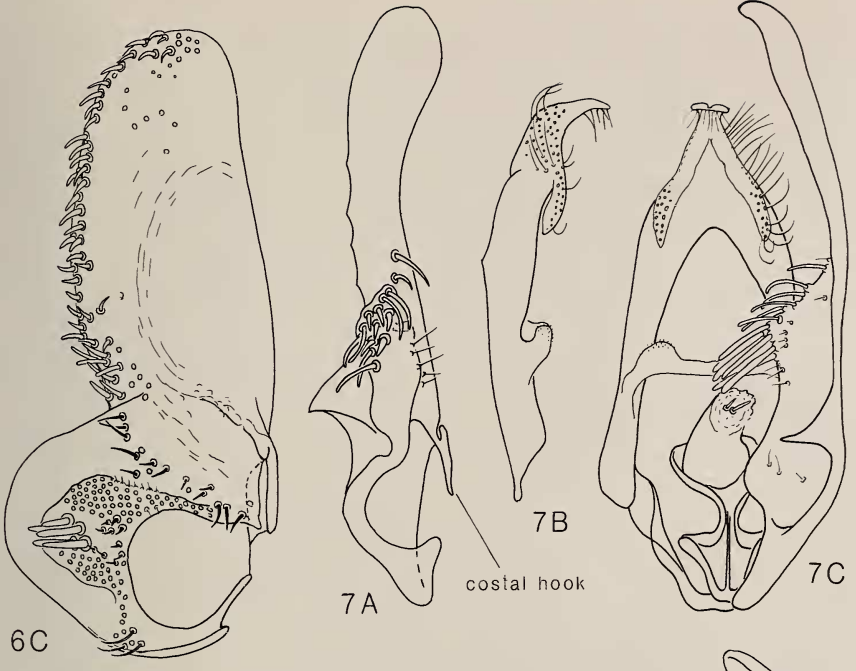
5C



6A

6B







FIGS. 5-9. Male genitalia of species of Olethreutinae. 5, *Endothenia melanosticta* (Walsingham): A, left valva; B, lateral views of uncus, tegumen, and socius; C, ventral view of genitalia. 6, *Bactra furfurana* (Haworth): A, lateral views of uncus, tegumen, and socius; B, ventral view of genitalia; C, left valva. 7, *Taniva albolineana* (Kearfott): A, left valva; B, lateral views of uncus, tegumen, and socius; C, ventral view of genitalia. 8A, *Endothenia melanosticta* (Walsingham): laterodorsal view of dorsal muscles. 8B, *Tia enervana* (Ersch.): ventral view of genitalia. 9, *Hulda impudens* (Walsingham): A, left valva; B, lateral views of uncus, tegumen, and socius; C, ventral view of genitalia.

row fringing the lateral and apical margins (Figs. 6A-B), in *Endothenia* species, setae are arranged into an apical row with a second group not in a row located dorsally (Figs. 5B-C, 6B-C). This strongly-curved and highly-specialized uncus is somewhat similar to that of the Archipini. However, the function of this strong uncus is quite different between these two groups. In the Archipini, both the uncus and the gnathos are well developed, and together they perform like the index finger and the thumb in gripping and holding the female during mating. In *Endothenia* and *Bactra*, however, the gnathos is poorly developed and the uncus alone is unable to grip and hold the female abdomen. Instead, the uncus, because of its hook shape with a distinctly-widened apex, or with a normal apex marginally armed with strong and stout setae, is able to anchor itself securely between the posterior ends of the anal papillae of the female during mating. In other species of the Olethreuti-



nae, the uncus is often fleshy or slightly sclerotized, narrow, fingerlike, straight or gently curved ventrally, and weakly setose (Figs. 7B-C, 8B, 9B-C), or absent. As a result, the uncus of many olethreutine species is much less effective in holding the female during copulation, and that of many others is virtually nonfunctional. With regard to the strong uncus and the classification of these two particular genera, Diakonoff (1956) remarked: "*Bactra* can be placed in *Endothenia* group of genera, with the remarkable spinose, hooked uncus in the males . . . ."

b) The tegumen of the male genitalia of *Endothenia* and *Bactra* is often short and distinctly bent downward, whereas that of other tortricid species is fairly straight, and directed posteriorly.

c) The dorsal side of the sacculus is not developed and expanded. As a result, the hinge line of the valva, i.e., the dorsal edge of the basal opening and the basal portion of the costa of the valva are parallel, or form a relatively straight line. Thus, when the valvae spread out to receive the female, their distal ends move only slightly away from the tegumen. In consequence, they remain virtually in a vertical position while holding onto the female genital segments during mating. Furthermore, in this position, the male would be able to effectively utilize the largely-expanded and strongly-setose sacculi in holding and applying lateral pressure onto the female organs during copulation. The costal hook is small and nonpronounced. In other Olethreutinae, the hinge line and the basal portion of the costa of the valva form an angle of 130 degrees or less, so that, as the valvae spread out to receive the female, their distal ends move away from the tegumen. During mating the pair of valvae stretch out horizontally pressing on along the lateral or ventrolateral sides of the abdomen. There are a few intermediate cases in Olethreutini in which the angle of the hinge line and the basal portion of the valva form nearly a straight line as in Bactrini. In these cases, however, the costal hook is distinctly of the Olethreutini and Eucosmini type, i.e., large, thumb-shaped, and produced from the base of the costa (Fig. 7A).

d) The tarsal setae, particularly those located at the distal end of tarsomeres 1-4 in both sexes, are greatly reduced and are much smaller and finer than surrounding scales in *Bactra*, *Endothenia*, *Gatesclarkeana*, and species of the Tortricini (Figs. 3-4). In other tortricid species, these setae are well developed, darkly pigmented and spinelike (Figs. 1-2).

On the basis of the present morphological evidence, *Bactra* and *Endothenia* form a distinct monophyletic group that is clearly distinct from other genera in the subfamily Olethreutinae. Therefore, I hereby assign them to the tribe Bactrini. Genera (in Diakonoff 1973) other

than *Bactra* in Bactrae and *Endothenia* in Endotheniae, respectively, were not included in the present study. Consequently, tribal placements of these genera (mostly from the south Asiatic region) remain to be investigated and clarified.

The genus *Gatesclarkeana* represents a unique group with extraordinary and unusual genital structure. However, *Gatesclarkeana* does not have well-developed tarsal setae, a character of reduction that has evolved independently a few times in at least three groups in the Tortricidae. Obviously, the shared loss of strong tarsal setae is likely a homoplasy between tribes Tortricini (Tortricinae) and Bactrini (Olethreutinae), or Tortricini and Gatesclarkeanini (Olethreutinae). The tribes in each of the above combinations are distantly related; each belongs to a different subfamily. In *Bactra* and *Endothenia* this tarsal character represents another aspect of affinity between these two genera; perhaps it is useful in strengthening characters a, b, and c above. Razowski (1989) included *Gatesclarkeana* in the subtribe Gatesclarkeanina. However, because of the loss of the strong tarsal setae in species of *Gatesclarkeana*, a condition also found in Tortricini and Bactrini, Gatesclarkeanini should remain as a distinct tribe.

The redefinition of the tribe Bactrini clarifies the taxonomic status of two Nearctic genera: *Taniva* Heinrich and *Hulda* Heinrich. The presence of well-developed apical setae on tarsomeres 1-4 and the lack of a typical bactrine uncus in the male genitalia of *Taniva* and *Hulda* clearly indicate that these genera do not belong to *Endothenia* as thought by Diakonoff (1973). Instead, the morphological evidence presented here confirms that they are best placed in the tribe Olethreutini, in which their generic status, as originally proposed by Heinrich (1926), is reinstated. *Taniva*, *Hulda*, and *Tia* remain as three monotypic genera: *Taniva albolineana* (Kearfott), *Hulda impudens* (Walsingham) and *Tia enervana* (Ersch.). *Hulda impudens* has male genitalia markedly different from all other olethreutine species, in which the tegumen is largely expanded ventrally with fine setae on the ventral surface, the uncus is a low median round wedge arising between two prominent distal lobes of the tegumen, and the socii are heavily sclerotized, flat and entirely bare on the distal half (Fig. 9). *Taniva* differs from *Tia* by the shapes of the socius, the valva, and the uncus (Figs. 7A-C, 8B).

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